Feasibility of a 5mN Laser-Driven Mini-Thruster, Phase I

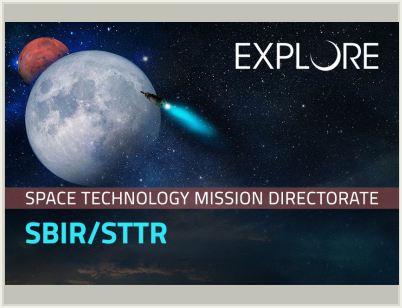
Completed Technology Project (2007 - 2007)

Project Introduction

We have developed a next-generation thruster under a Phase II SBIR which we believe can meet NASA requirements after some modifications and improvements. It is the first practical example of chemically-augmented electric propulsion, using efficient laser diodes focused on an exothermic fuel tape to make a jet. We own the patents on this technology. Advantages of our thruster technology are large thrust/power ratio (up to 1.35mN/W) and thrust density, small minimum impulse bit (10nN-s) and instantaneous thrust control. Other advantages are absence of magnetic fields, high voltage, toxic chemicals, fuel and/or oxidizer storage tanks, heaters or valves, and the fact that the source of concentrated energy is physically removed from the thrust converter, so that only the fuel, not some engine component, wears or ablates during operation. Engine lifetime will be limited only by the amount of fuel onboard, not by the 200k year lifetime of the diode lasers which generate the ms pulses. Problems which we want to address in this Phase I effort are inadequate ablative layer thickness control which has led to excessive rms thrust noise, a footprint which is larger than we would like and plume contaminants generated by carbon doping used for laser absorption in the present fuel tape. Our goal is 1% rms thrust noise and an order-of-magnitude reduction in contaminants deposited by the thruster plume.

Anticipated Benefits

The same advantages and applications given above also apply to non-NASA satellite applications. We are actively talking with the Boeing Co. and Northrop-Grumman about these. The work we propose will provide NASA with an innovative, miniature, precision propulsion system which is robust, lightweight, long-lived, with high thrust/power ratio and essentiallly zero erosion of any components beside fuel. The LPT's standard application is to microsatellite nanopositioing and stationkeeping. In that role, it has unique capabilities. It could be useful as a compact, high thrust device for extending complex structures in space. It is the first thruster device in the new field of chemically augmented electric propulsion developed by PA. Because our exothermic ablation fuel polymers have been carefully developed and optimally applied, at 500?N/W the mini-LPT has the largest thrust-to-system-prime-power ratio among microthrusters. It also has macro-level thrust in a micro-thruster. For this reason, it can replace resistojets, cold gas thrusters and other devices where programmable thrust in a low mass package is needed. It also has applications as an electrodeless plasma source.



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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Glenn Research Center (GRC)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

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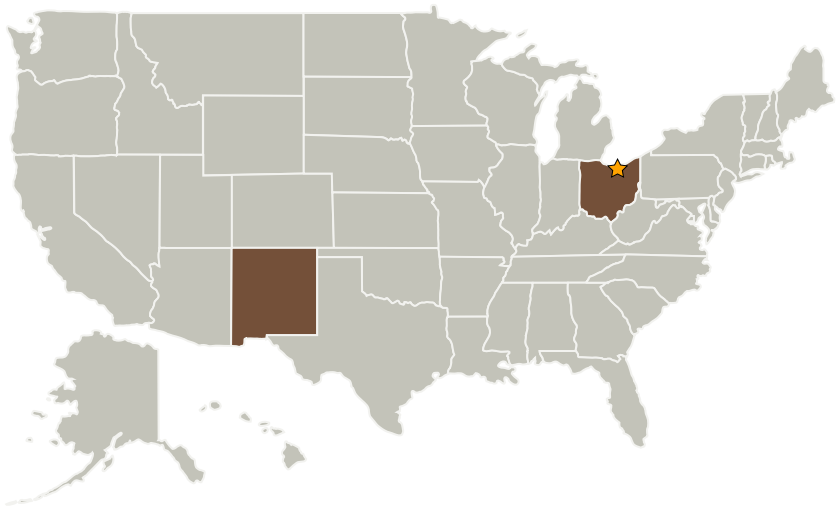
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Glenn Research Center(GRC)	Lead Organization	NASA Center	Cleveland, Ohio
Photonic Associates, LLC	Supporting Organization	Industry	Santa Fe, New Mexico

Primary U.S. Work Locations	
New Mexico	Ohio

Project Management

Program Director:
Jason L Kessler

Program Manager:
Carlos Torrez

Project Manager:
Jonathan L Van Noord

Principal Investigator:
Claude Phipps

Technology Areas

Primary:

- TX01 Propulsion Systems
  - TX01.4 Advanced Propulsion
    - TX01.4.3 Nuclear Thermal Propulsion